

WHAT WE CLAIM IS:

1. An apparatus, comprising:
an optical fiber having a tapered portion with a lateral surface and an end face;
an electrically conducting layer located on a portion of a lateral surface of the
5 tapered portion of the optical fiber; and
wherein the tapered portion and electrically conducting layer are configured to
generate surface plasmons that propagate along a surface of the conducting layer in
response to light of a preselected wavelength arriving at an end of the tapered portion.
- 10 2. The apparatus of claim 1, wherein an interface between said optical
fiber and the electrically conducting layer comprises an array of structures configured
to convert a portion of said surface plasmons into light that propagates out of a second
end of the tapered portion.
- 15 3. The apparatus of claim 2, wherein the structures have a regular spacing
along a central axis of said tapered portion.
4. The apparatus of claim 3, wherein each structure comprises a bump of
material of the conducting layer, a hole in the conducting layer, or a bump of material
20 with a dielectric constant differing from the dielectric constant at adjacent portions of
the optical fiber.
5. The apparatus of claim 3, wherein a cross section of each structure has
a height of λ or more from the interface and a width of λ or more along the interface,
25 wherein λ is a wavelength of light that an untapered portion of the optical fiber is
adapted to carry.
6. The apparatus of claim 1, wherein the conducting layer comprises an
array of structures located near a first end of the tapered port and configured to
30 convert a portion of said received light into said surface plasmons.

7. The apparatus of claim 6, wherein the conducting layer comprises another array of structures located near a second end of the tapered portion and configured to convert a portion of said surface plasmons into light that propagates out of a second end of the tapered portion.

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8. The apparatus of claim 1, wherein the conductive layer is a metal layer.

9. The apparatus of claim 1, further comprising a scanning optical microscope; and

10 wherein the microscope comprises a mechanical scanner and the optical fiber, the mechanical scanner being capable of mechanical moving the end face of said fiber across a sample.

10. An apparatus, comprising:

15 an optical fiber having a tapered portion and an untapered portion, the tapered end portion having an end face, the untapered portion having a larger diameter than the end face;

a metal layer located on a lateral surface of the tapered portion; and

20 wherein a surface of the metal layer has an array of structures that are substantially regularly spacing along a portion of the length of the tapered portion.

11. The apparatus of claim 10, wherein the array is adjacent the end face and the metal layer has a second array of regularly spaced structures located near the untapered portion.

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12. The apparatus of claim 10, wherein, at least, some of the structures form rings around more than $\frac{1}{2}$ of the circumference of the fiber.

13. The apparatus of claim 10, wherein at least some of the structures are
30 located along an interface between the tapered portion and the metal layer.

14. The apparatus of claim 10, wherein at least some of the structures are located along an external surface of the metal layer, the metal layer being between said external surface and the tapered portion of the optical fiber.

5 15. The apparatus of claim 10, wherein the structures are one of pits on a surface of the metal layer, holes in the metal layer, and bumps on a surface of the metal layer.

10 16. The apparatus of claim 10, further comprising a scanning optical microscope; and
wherein the microscope comprises a mechanical scanner and the optical fiber, the mechanical scanner being capable of mechanical moving the end face of said fiber across a sample.

15 17. The apparatus of claim 10, wherein each structure comprises a bump of material of the metal layer, a hole in the metal layer, or a bump of material with a dielectric constant differing from the dielectric constant at adjacent portions of the optical fiber.

20 18. The apparatus of claim 10, wherein a cross section of each structure has a height of 0.1λ or more from the surface of the metal layer and a width of 0.1λ or more from the surface of the metal layer, wherein λ is a wavelength of light that an untapered portion of the optical fiber is adapted to carry.

25 19. A method of fabricating an optical fiber device, comprising:
providing an optical fiber having a portion with a tapered diameter, the portion having a central axis and a lateral surface; and
forming a metal film on the lateral surface of the tapered portion such that one surface of the metal film has an array of structures, the structures being regularly
30 spaced along a central axis of the tapered portion.

20. The method of claim 19, further comprising performing a mask-controlled etch or a mask-controlled deposition to produce second structures on said lateral surface of the tapered portion, the second structures being regularly spaced along a portion of the length of said lateral surface.

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21. The method of claim 20, further comprising then, forming a clean end face on a segment of said tapered portion, an array of said structures located adjacent said end face.

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22. A method of transporting light, comprising:
receiving light at one end of an optical fiber;
converting a portion of the received light into surface plasmons such that the surface plasmons propagate along the length of a portion of the optical fiber; and
reconverting a portion of the surface plasmons into output light at a second
15 end of the optical fiber.

23. The method of claim 22, wherein the converting produces surface plasmons that propagate along a surface of a metal layer that covers a lateral surface of the optical fiber.

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24. The method of claim 23, wherein the converting includes producing the surface plasmons in a first regular array of structures on said surface and the reconverting includes producing the output light in a second regular array of structures on a surface of said metal layer.

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25. The method of claim 23, wherein the optical fiber is tapered and the receiving comprises receiving said light at an end face of the optical fiber or receiving said light from an untapered portion of optical fiber.